

Economic feasibility in the building stock

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1. Introduction

Economic feasibility of HPs with MPC in standing residential buildings

Why standing residential buildings?

- Standing buildings dominate building stock; exception Luxembourg
 - Refurbished buildings have higher shifting potential/energy demand
- Overall higher potential (economic & energetic) than new buildings

Basic requirements:

- Benefits for building owner
- Refurbishment



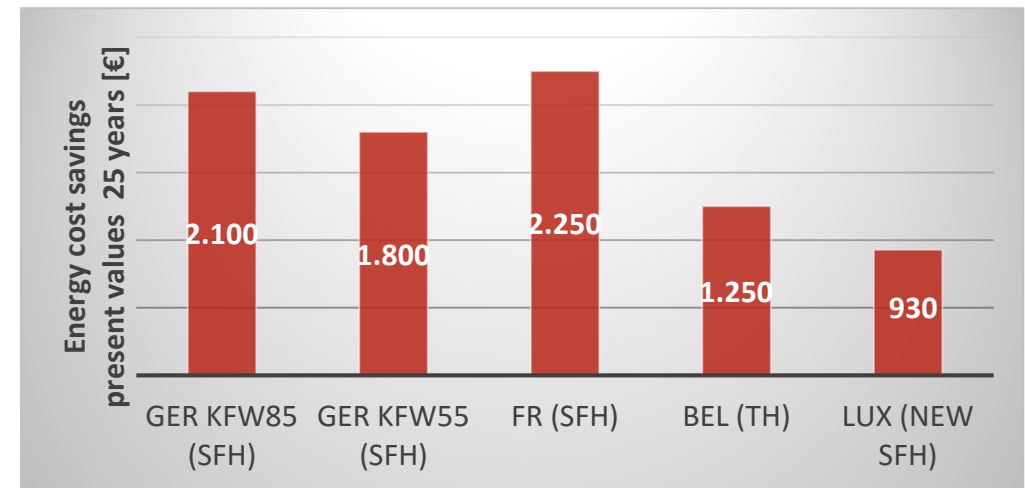
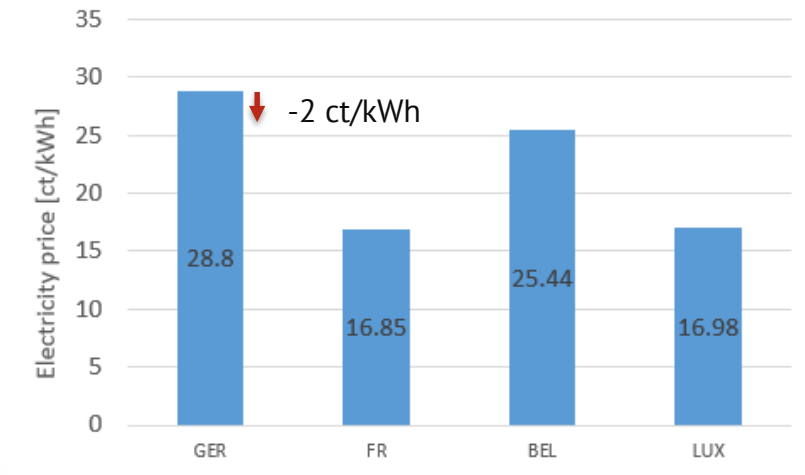
Source: Tabula Webtool

2. Feasibility of HPs with MPC – Possible benefits for building owner

Potential additional costs uncertain:

- Higher maintenance costs (depending on implementation)
- Higher investment costs (depending on implementation)
- Increased storage size (optional)

Estimated savings with 2 ct/kWh average price reduction



2. Feasibility of HPs with MPC – Refurbishment concept example

	Germany KfW55	France Min. Requirements	Belgium Min. Requirements
HP air	6 kW	7 kW	4 kW
Storage volume	500 l	500 l	500 l
Outer wall	18 cm 035 PS	14 cm 035 PS	14 cm 035 PS
Windows	triple-pane windows	double-pane windows	double-pane windows
Roof	eq. 25 cm 035	10 cm 035	eq. 18 cm 035
Basement ceiling	14 cm 035	10 cm 035	14 cm 035

2. Feasibility of HPs with MPC – Refurbishment details Germany 2016

	KfW55 – without Controller		KfW55 – with Controller	
	Initial costs [€]	Follow-up costs [€]	Initial costs [€]	Follow-up costs [€]
Heating system				
HP air + buffer storage (500l) + el. res. heater	11,880	9,937	11,880	9,937
Thermal building envelope				
Outer wall	22,952	0	22,952	0
Windows	11,872	0	11,872	0
Roof	32,688	0	32,688	0
Basement ceiling	8,112	0	8,112	0
Energy costs (heat)*1	19,299		18,328	
Present values (PV)	116,740		115,770	
Estimated state grants	26,251*2			
PV incl. funding grants	90,489		89,519	
Specific costs	692.3 (€/m ² RFA)		684.9 (€/m ² RFA)	

*1: present value 25 years, *2: KfW430 KfW55 (30 %), RFA: Reference floor area (0,32 * heated volume)

2. Feasibility of HPs with MPC

Radiant floor heating system

Advantages

- Reduced el. consumption; energy savings: ~500-600 € over 25 years
- More space (no radiator)
- Comfort

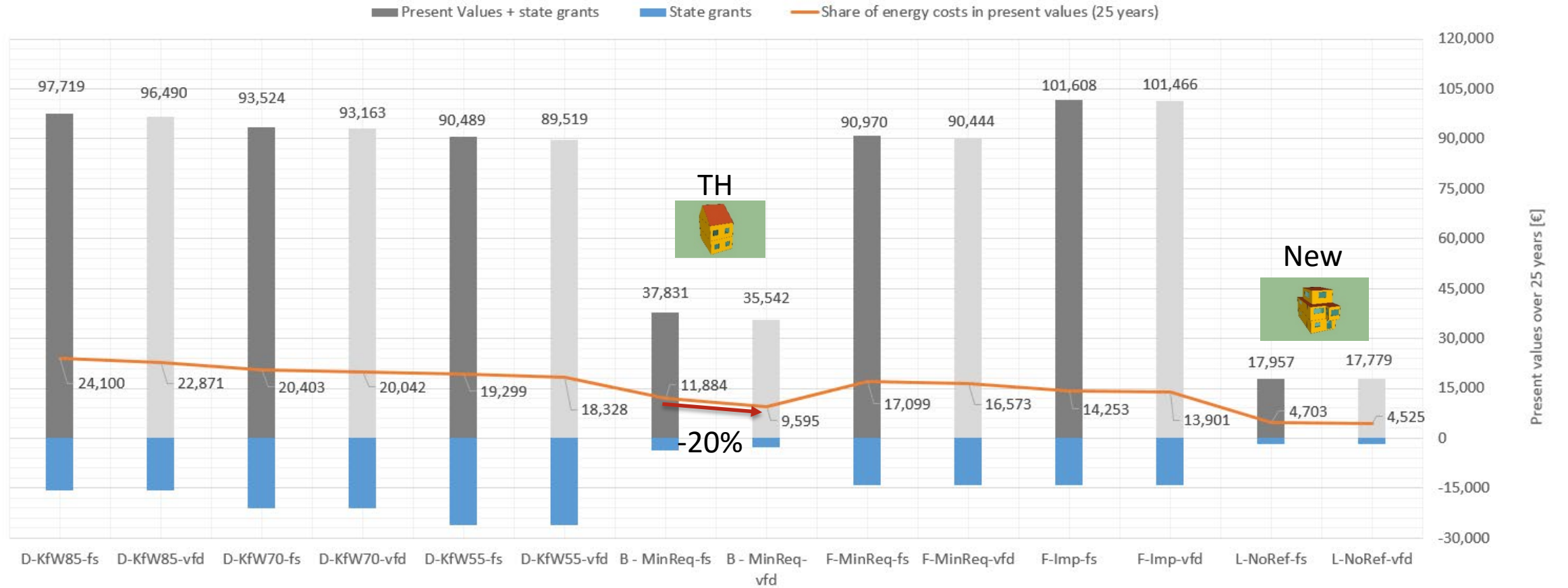
Disadvantages

- Additional investment costs of 100-200 €/m²
- Total Investment costs at least 10,000 € per building

Economic perspective:

- When possible use of existing radiators
- Reduced supply temperature due to refurbishment

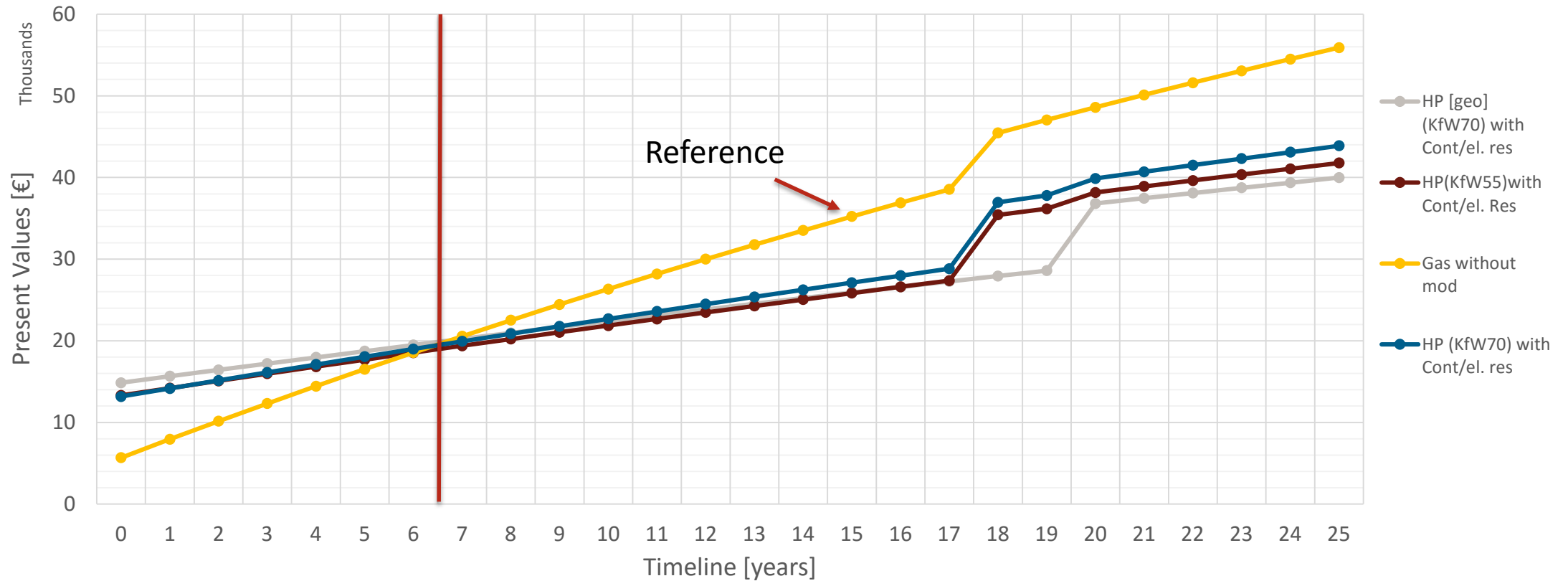
2. Feasibility of HPs with MPC – Greater Region



3. Present values of HP refurbishments in comparison

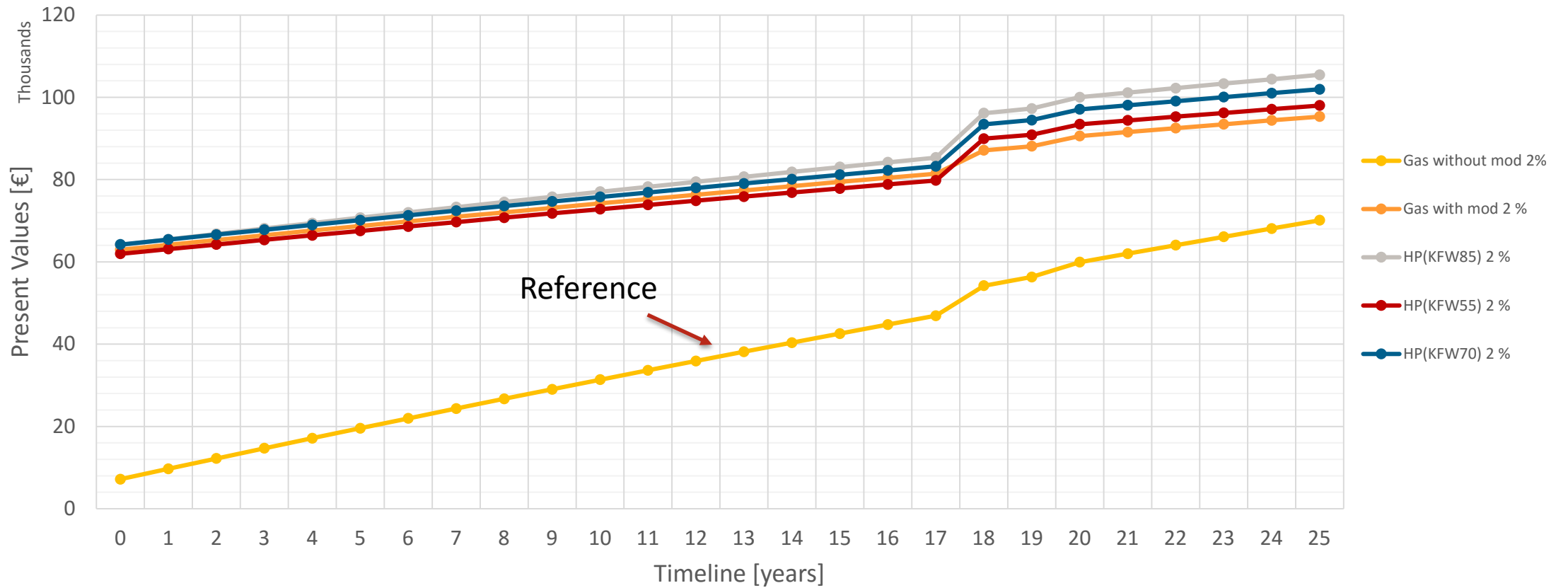
- a) Energy related costs
- b) Full costs

3. Present values of HP refurbishments in comparison – energy related

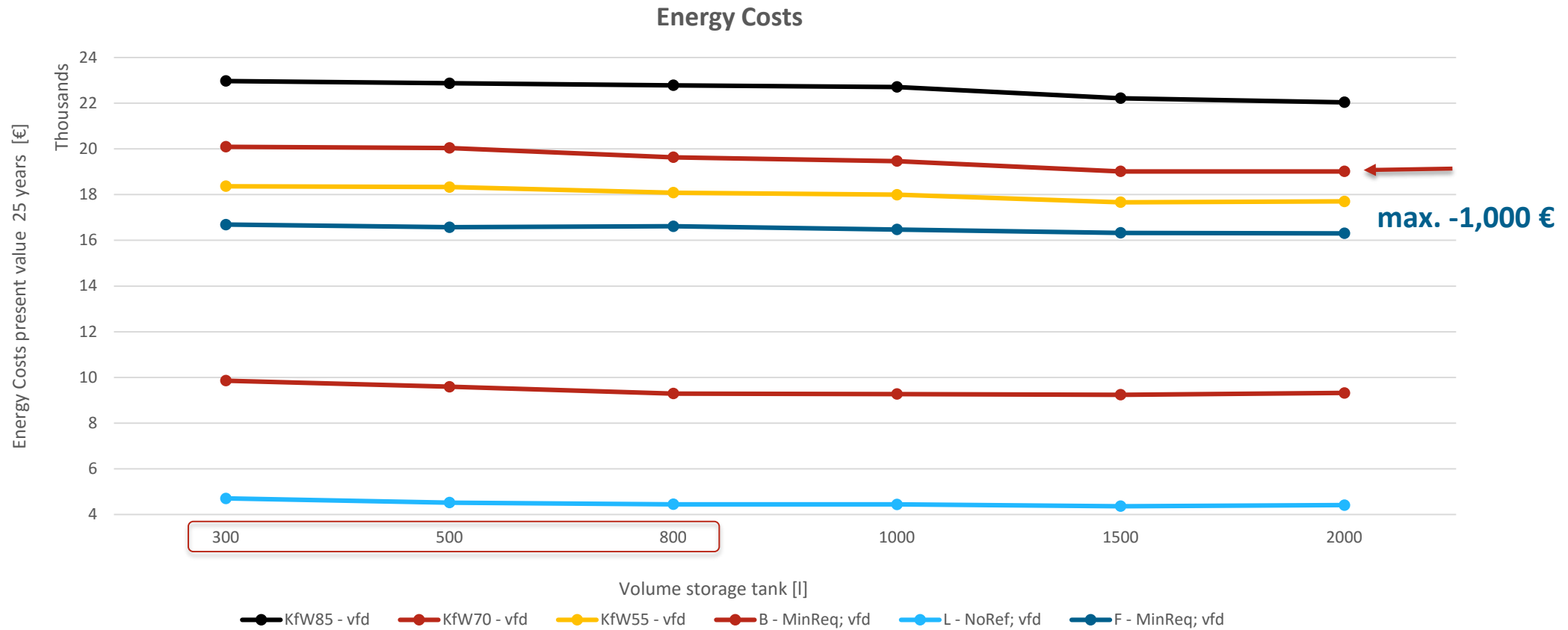


Additional refurbishment costs German ref. building: 44,500 €

3. Present values of HP refurbishments in comparison – full costs



4. Increased storage tank volumes



5. Conclusion

Refurbishments:

Germany: **KfW55 standard**

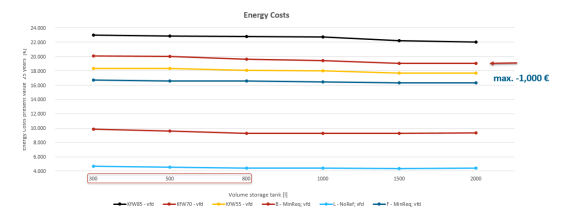
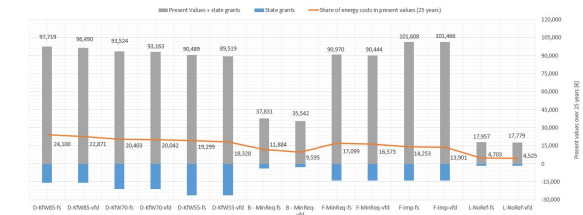
- Funding grants compensate additional invest costs

France & Belgium: **Min. requirements**

- No additional funding grants for additional insulation

Storage tank volumes:

- Compensation possible depending on tariff
- With given tariff 300-800l recommended



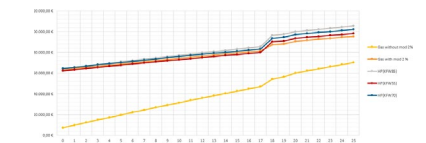
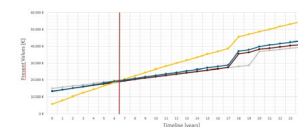
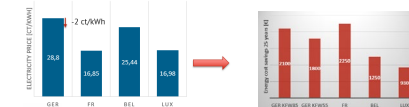
5. Conclusion

Roll-out feasible with limiting factors:

- Potential in new buildings
 - Lower demand
 - HP share rising
- Standing buildings (focus)

- Only small expected benefits for building owner

- Refurbishment necessary, only feasible if intended anyway
- Refurbishment rate difficult to increase



Thank you for the attention!

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Abbreviations

- HP: Heat pump
- MPC: Model predictive controller
- PV: Present Value
- SFH: Single family house
- TH: Terraced house
- Fs: Fixed speed
- Vfd: Variable frequency drive
- MinReq: Minimal requirements
- Imp: Improved
- Geo: Geothermal
- El Res.: Electrical resistance heater
- Mod: Modernization
- NoRef: No refurbishment